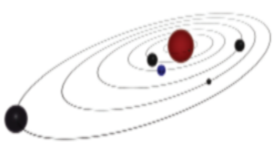
A few idea starters to help you use . . .

The **Periodic Chart** for the non-chemist

In Science

There are 26 letters in the English alphabet, and they make all the words we use. It is the same with the elements— everything that exists is made from them.

Solar System



- Modeling—How big is our solar system. Make sure to use the Solar Model on page 4 to make an accurate scale model of our solar system. How big is an atom? Use the same model.

Then, here are a few tidbits—

— To travel the equivalent of one light year in our model, one would have to walk a distance of 1,000 miles. As big as it is, our solar system is nowhere near a light year in size.

— To reach the next nearest star system, Alpha Centauri, on our model would require a walk over 4,000 miles long.

Atoms & Elements

- Provide descriptions of the elements (no names) and create different methods to categorize; such as solid, liquid, gas, metal, nonmetal, color of element, radioactive, synthetic.
- Identify elements that don't have symbols that match their names.

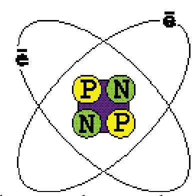
ACTIVITY: Common Elements in Our Home

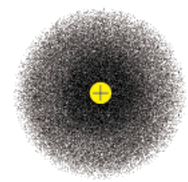
We use elements and compounds everyday. Below on the left are the common names of several everyday products you will find in your home and their chemical formulas. Their scientific names are on the right. Using the periodic table, match the common names to the scientific names.

1. Ammonia, NH_4OH	12	Silicon dioxide
2. Baking soda, $NaHCO_3$	10	Hydrogen peroxide
3. Vinegar, CH_3COOH	1	Ammonium hydroxide
4. Chalk, $CaCO_3$	11	Sodium chloride
5. Charcoal, C	4	Calcium carbonate
6. Diamond, C	8	Sucrose
7. Dry ice, CO_2	2	Sodium bicarbonate
8. Sugar, $C_{12}H_{22}O_{11}$	3	Acetic acid
9. Graphite, C	7	Carbon dioxide
10. Peroxide, H_2O_2	5, 6, 9	Carbon
11. Table salt, NaCl	5, 6, 9	Carbon
12. Sand, SiO_2	5, 6, 9	Carbon

- Pick 3 or 4 planets. Produce a Venn diagram of the common elements. Is there a major difference between the inner and outer planets?
- Provide list of the elements in the atmosphere and crust (if available) of other planets. Discussion: Can our life exist on this planet. If not, what is needed? Write compare and contrast paragraphs about the elemental make-up of the planets.
- What kinds of elements are common on the inner plants? What kinds of elements are common on the outer planets? List, Graph, Venn Diagram.
- Titanium is more common than iron on the moon. What do you think you would build things out of when it comes time to colonize the moon? Where, other than Earth, could you get water in our solar system? Sulfur? Iron?

What does an atom look like? No one knows, but they think . . .





Textbooks always have drawings of atoms. On the left is an earlier model of the atom showing that electrons travel in definite paths like planets around the sun.

The newer model on the right shows an *electron cloud,* because scientists realized they did not know the precise path of each electron but only the likelihood of where it might be.

- How big is an atom? Split a cherry pie in half 90 times. After 5 splits, an 8" diameter pie will be 1/2 inch; 10 splits= 1/64 inch; 15 splits= 1/2048 inch . . 90 splits will be the size of an atom.
- Check out the Solar Model guide to convert it to a model of the hydrogen atom.
- Provide a list of common compounds and have students tell what elements it is made from.
- Which elements are liquid at room temperature? (Mercury and bromine) Which elements would be liquid on a hot day? (add rubidium and gallium) Which elements would be liquid on Venus? (add tin, lead, zinc)—Graph, List, Illustrate. Check out other unique characteristics of the elements.

. . . a little more about atoms.

- Assign each student 5 or so elements to research where they are found, when they were discovered, how they are used.
- A little research activity: create a table like the one at the right and have students use different resources to fill in the blanks.

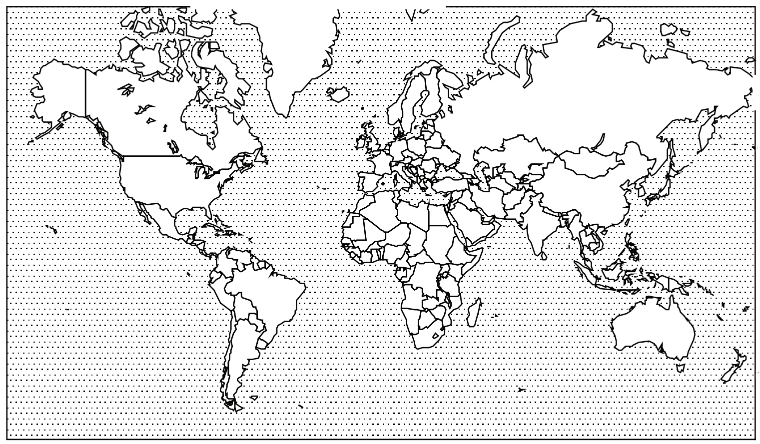
Element	Symbol	Number of Protons	Origin of Symbol
Aluminum	Al	13	First two letters of name
Zinc	____	_____	First & third letters of name
Nickel	____	_____	First two letters of name
Sulfur	____	16	First letter
__________	Au	_____	Latin
Copper	____	29	____________________
Iron	Fe	_____	____________________
Potassium	____	19	____________________
__________	Ag	_____	Latin

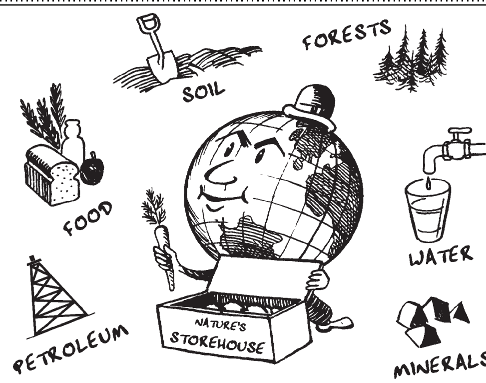
In Geography

- Find out where the elements were discovered and identified. You'll be very surprised.
- List (collage) of products we all use, find out what elements they are made from, and identify the nations where those elements are mined. Check out Mii's **Dig A Little Deeper** themes for products and ingredients. Or use products with ingredient labels.
- With string or push-pins on a world map, show the major locations where the elements are known to exist or are mined. Is there any major relationship between the existence of these elements (minerals and mining) and the rich or poor status of those nations? Yes, but there are exceptions: Japan has almost no mineral resources (but has incredible ingenuity) and many of the African nations have extensive resources (but have long histories of political instability).

Where in the world were the elements discovered

Where in the world is Gold found





Life Processes— Health & Nutrition

Produce a comparison (table; graph) of the elements in life processes, from essential to beneficial Is there a difference between plant and animal life?

Vitamins— what elements are they built around? All have carbon, hydrogen, and oxygen; many also have nitrogen. B_1- also has manganese; B_{12}- has cobalt.

Which elements are necessary for plants to grow? Find out why, and what happens when plants don't get those elements. Do the same thing for animals.

Compare the elements needed by plants and animals for full health.

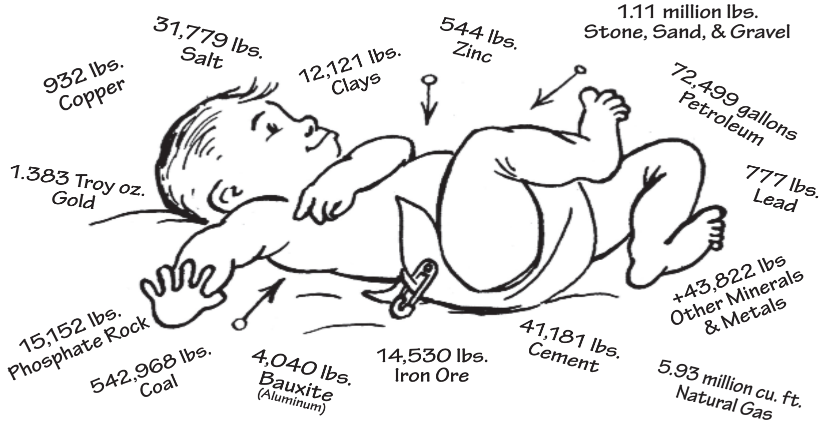
Get MII's *Elements Comprising the Human Body* poster for a list of the various elements in people, and the important role those elements play in life processes.

What Do You Think about the phrase,

"all things are poisonous and yet there is nothing that is poisonous; it is only the dose that makes a thing poisonous."

Paracelsus
Swiss physician and alchemist
1493-1541

Every American Born Will Need...



2.9 million pounds of minerals, metals, and fuels in their lifetime

Learn more at www.mii.org

The Uses of Elements in Modern Society

Language Arts

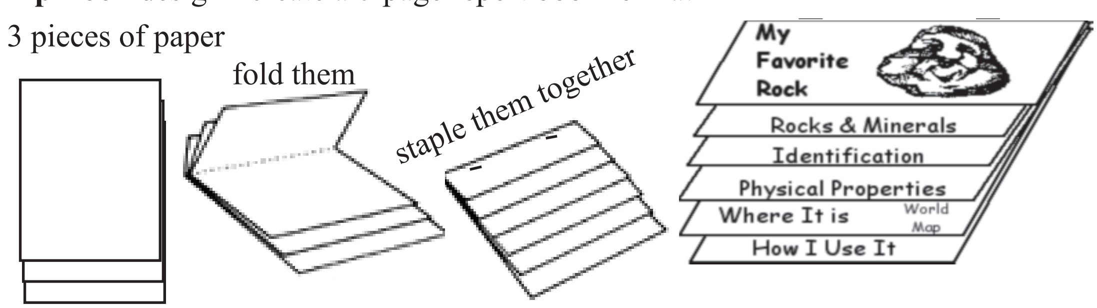
- Create a flip-book of an element and all the ways we use that element.
- Creative writing— pretend to be an element— write your life story.
- The average American born today will use more than 3 1/2 million pounds of minerals, metals, and energy fuels in their lifetime. How can you possibly use nearly a ton of copper in your lifetime? Find out.
- The average automobile weights nearly 3,000 lbs and contains about 38 different metals and minerals. How many cars has your family bought in your lifetime? . . . in your parents lifetime?
- Which elements help provide the color picture in television sets?
- Your house contains more than a quarter of a million pounds of different minerals and metals, plus a variety of timber products. IF you had to build a house using resources that are near where you live, what would it be made of? Are there enough resources near you for all of your friends to do the same thing?
- 100 million computers are hooked to the Internet (worldwide). Their demand for electricity is equal to about 13% of the current U.S. use of electricity (enough to keep California's 11 million households running for more than three years). This use didn't really exist 10 years ago.

  Also, computers use no fewer than 33 different elements in all the components. Each year, more than 47,000 pounds of newly mined minerals must be provided for every person in the US, just to maintain our standard of living. If necessary, what are you willing to do without? Make a list. How will your life change by doing without certain things?

In History

- Create a time line of when the elements were discovered.
- Study the life-style and conditions of living before and after those discoveries. Can you draw a correlation? Remember the Stone Age, the Iron Age, the Bronze Age, the Industrial Age, the Age of Computers— they all came about because of the technology of learning how to use our mineral resources.
- There have been numerous wars throughout history. Can you find a connection between the availability of resources and the cause of those wars?

Flip Book design - create a 6-page report book format



A Model, A Walk, or A Happening

What your students thought they knew, they can now comprehend

How Big Is Our Solar System How Big Is An Atom

An Example from the Astronomical Workshop program: **The Thousand-Yard Model** or The Earth as a Peppercorn

Introduce the concept of scale.

The Earth is eight thousand miles wide! A peppercorn (representing the Earth) is eight hundredths of an inch wide. What about the Sun? It is eight hundred thousand miles wide. The ball representing it is eight inches wide. So, one inch in this model represents a hundred thousand miles in reality.

This means that one yard (36 inches) represents 3,600,000 miles.

Take a pace: this distance across the floor is an enormous space-journey called *"three million six hundred thousand miles."*

Now, what is the distance between the Earth and the Sun? It is 93 million miles. In the model, it is 26 yards.

This still may not mean much till you get one of the class to start at the side of the room and take 26 paces. He comes up against the opposite wall at about 15!

Clearly, it will be necessary to go outside.

Gather your planets . . .

First, the objects representing the Sun and planets need to be collected. The objects in parentheses are suggestions that are about the right size.

- Sun **= ball 8 inches in diameter (bowling ball)**
- Mercury **= 0.03 inch (pinhead)**
- Venus **= 0.08 inch (peppercorn)**
- Earth **= 0.08 inch (peppercorn)**
- Mars **= 0.04 inch (pinhead)**
- Jupiter **= 0.9 inch (chestnut or pecan)**
- Saturn **= 0.7 inch (hazelnut or acorn)**
- Uranus **= 0.3 inch (coffee bean)**
- Neptune **= 0.3 inch (coffee bean)**
- Pluto **= 0.02 inch (pinhead)**

To prevent your *"planets"* from getting lost, glue them to a 3" by 5" card (stick the pin through the card, or their heads will be virtually invisible).

. . . spread them out.

Since this model is 3,000 feet long, it must be set up outside, on a straight, flat stretch of ground.

Practice first. It is difficult for most adults to take a pace that is 3 feet long.

- **The** Sun **is the starting point.**
- **From the** Sun to Mercury **is 10 yards (roughly 10 adult paces)**
- **From** Mercury to Venus **is 9 yards (paces)**
- **From** Venus to Earth **is 7 yards (paces)**
  (From Earth to Moon **is 2.4 inches)**
- **From** Earth to Mars **is 14 yards (paces)**
- **From** Mars to Jupiter **is 95 yards (paces)**
- **From** Jupiter to Saturn **is 112 yards (paces)**
- **From** Saturn to Uranus **is 249 yards (paces)**
- **From** Uranus to Neptune **is 281 yards (paces)**
- **From** Neptune to Pluto **is 242 yards (paces)**

The distance of this model adds up to 1,019 paces.

This model can easily be adapted to displaying an atom as well.

- Instead of the Sun, our bowling ball will now represent the proton at the center of a hydrogen atom.
- The attendant electron in the atom would be represented by a speck of dust almost too small to see. It would have to be placed as far out as Pluto is in the solar system model.

In reality, both the very small and the very large are primarily made of empty space.

Women In Mining Education Foundation

MINERAL AND ROCK MATCH

PURPOSE

Students need to have a basic introduction to rocks and minerals as well as some knowledge of the periodic table before doing this activity.

Elements are the simple building blocks of the Earth. Minerals are simply made up of one or more elements. Rocks are divided into three categories depending upon how they were formed. Sub-categories are used for some rock types.

This activity is to help students learn the Periodic Table of Elements and how some minerals are actually combinations of several elements. It will also help increase their knowledge of the three types of rocks and some identifying features of both selective minerals and rocks.

MATERIALS

- Cards with minerals or rock names
- Cards with identifying information
- Cards with element(s) symbol

INSTRUCTIONS

Divide the students up into three groups. Each student in a particular group will have one type of card, i.e., one group will each get a mineral or rock while the other two groups will each have one of the remaining groups.

Students will be given a set amount of time (5 to 10 minutes) to find the other two cards that match the one they have. Once all cards are matched, have different ones read their cards and explain how they arrived at their match.

Be sure to allow time for questions and further explanation of identification possibilities. If desired, students could study the rock cycle and mineral identification before this activity to increase their knowledge of both rocks and minerals.

OPTIONS

Have another set of cards made up with products from the minerals and rocks used and divide the students into four groups. Have a student with an element card hold the card up and wait for the other students to hold theirs up. Reverse the order or exchange cards until the students are comfortable with their understanding of elements and rocks.

Introduce alloys and compounds into the game with the teacher calling out the name of a mixture and the students with the correct cards can stand. Add other mineral and rock cards as desired.

The majority of materials in this special 12-page supplement have been developed by and/or are freely distributed by the Women In Mining Education Foundation.
See more of their work at www.womeninmining.org

Mineral Identification— to create cards, photocopy this sheet onto 11” by 17” paper, using 130% enlargement

Mineral **Barite**	**$BaSO_4$**	Gray colored, hardness of 3 to 3.5, streaks white, glassy or pearly luster and 4.5 specific gravity.
Mineral **Fluorite**	**CaF_2**	White, pink to pale green, streaks white with a glassy luster, 4.0 hardness and a 3.1 to 3.3 specific gravity.
Rock **Coal**	**Sedimentary** **C**	Dark brown to black, glassy texture, brittle. Hardness and specific gravity vary.
Mineral **Gold** **(Native)**	**Au**	Yellow, metallic luster, streaks yellow, a 3.0 hardness and 15.3 to 19.3 specific gravity.
Mineral **Quartz**	**SiO_2**	White, pinks, browns & blacks with a glassy luster, streaks white, has a 7.0 hardness and a 2.6 specific gravity.
Mineral **Copper Ore** **(Chalcopyrite)**	**$CuFeS_2$**	Brass-yellow, with a metallic luster, streaks black, a 3.5 to 4.0 hardness and a 4.0 specific gravity.
Mineral **Gypsum**	**$CaSO_4 . 2H_20$**	Clear to white, streaks white, glassy to chalky luster, a 1.5 to 2.0 hardness and a 2.3 specific gravity.
Mineral **Magnetite**	**Fe_3O_4**	Black with a reddish brown streak, metallic luster, 6.0 hardness and a 5.0 specific gravity.
Mineral **Silver** **(Native)**	**Ag**	Gray-white with a silver streak, bright metallic, 2.5 to 3.0 hardness and a 10.0 to 12.0 specific gravity.
Mineral **Pyrite**	**FeS_2**	Brassy, dark yellow with a greenish-black streak, metallic luster, hardness of 6.0 to 6.5, specific gravity 5.0 to 5.2. Cubic crystals.
Mineral **Sulfur**	**S**	Yellow, resinous to glassy luster, streaks pale yellow, 2.0 hardness and a 2.0 specific gravity.
Mineral **Calcite**	**$CaCO_3$**	White, clear, yellow, pink or blue, with a white streak, glassy luster, 3.0 to 4.0 hardness and a 2.7 specific gravity.

Rock Identification— to create cards, photocopy this sheet onto 11” by 17” paper, using 130% enlargement

Rock **Granite**	**Igneous, Intrusive** SiO_2, Al, K, Na, Ca Numerous types	Coarse grained, light colored, Chiefly quartz (up to 50%) and feldspar. Extremely hard.
Rock **Gabbro**	**Igneous, Intrusive** Numerous types. Ca, Al, Si, O, Fe. Maybe P and Ti	Fine to coarse grained, dark colored with interlocking grains of feldspar and hornblende.
Rock **Basalt**	**Igneous, Extrusive** Si, O, Al, Mg, Fe, Na, Ca. Numerous types	Dark, fine grained. Usually rich in iron and magnesium.
Rock **Pumice**	**Igneous, Extrusive** Usually 65% to 70% SiO_2 and 10% to 20% Al_2O_3 Usually K, Na, and Ca	Light and frothy. Gas bubbles are trapped in the rock during rapid cooling.
Rock **Conglomerate**	**Sedimentary** Numerous types: particles cemented by $CaCO_3$, SiO_2, and iron oxides (FeO, Fe_2O_3, Fe_3O_4)	Coarse grained, with fine grained matrix cemented by calcite, silica or iron oxide.
Rock **Sandstone**	**Sedimentary** Numerous types, mostly SiO_2, cemented by clay-sized sands or silica or carbonate cement	Fine to medium grained, composed of many rounded or angular fragments set in fine-grained matrix.
Rock **Shale**	**Sedimentary** Numerous types. Mainly contains Si, O, Al, Mg, Fe, K, Ca, Na, sometimes C	Fine grained, formed by compressing clay, silt or mud. Breaks easily into thin layers.
Rock **Limestone**	**Sedimentary** 50% of rock is $CaCO_3$ and/or $CaMg(CO_3)_2$	Fine to coarse grained with 50% or more being a carbonate rock.
Rock **Gneiss**	**Metamorphic** Si, O, Al, K, Na, Ca. Maybe Fe, Ti, Mg, Mn	Coarse grained. Light-colored bands (quartz & feldspar) of granular texture. Dark bands (mica and/or hornblende) are layered (foliated).
Rock **Quartzite**	**Metamorphic or Sedimentary** Mainly composed of SiO_2	Formed by recrystallization of sandstone or chert, or grains cemented together by fine silica.
Rock **Schist**	**Metamorphic** Numerous types. Mainly O, Si, Al, Mg	Parallel layers of flaky minerals such as mica. Easily split or cleaved. Crystalline rock. Occurs in thin layers.

MINERAL IDENTIFICATION

PURPOSE: This activity will teach the student to identify minerals using the physical properties of each mineral. This is accomplished through observation and testing of the minerals involved.

INSTRUCTIONS:

1. Set up mineral stations for each mineral the students are to identify. If necessary, some stations may have two minerals to identify.

2. Each station should be equipped with one each of the following items:
   - Eye dropper
   - Vinegar or 10% solution of HCL (Hydrochloric acid)
   - Glass plate
   - Penny
   - Streak plate (white unglazed porcelain)
   - Magnet
   - Steel blade or knife

3. Divide students into equal groups. Have the number of student groups match the number of mineral stations.

4. Distribute to each student the Mineral Worksheet. Have students read the descriptions at the bottom of Mineral Worksheet.

5. Have student groups move to the mineral stations with one group of students at each station. Have the students perform the physical property tests listed and record the test results on the Mineral Worksheet.

6. Rotate the student groups through each of the work stations performing the tests at each station. Allow 3 to 5 minutes per mineral per station.

7. Hand out the Mineral Identification sheet (page 2 of this packet). The Rock Identification sheet (page 3) would provide a real challenge.

8. Have students compare their test results with the Mineral Identification sheet. Can the students correctly name each of the minerals using their test results? If the students can correctly identify their mineral from the testing, have them write the name of the mineral on the Mineral Worksheet.

REVIEW: The students learned to perform tests for physical properties of minerals, observe the test results and then identify a mineral using the test results.

Name ______________________________

MINERAL WORKSHEET

Using Physical Properties to identify minerals

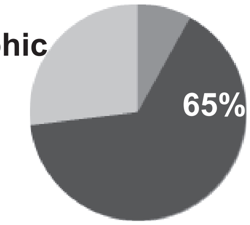
Sample #	Color	Feel	Streak	Smell	Luster	Magnetic	Chemical	Hardness	Weight
Sample #	Color	Feel	Streak	Smell	Luster	Magnetic	Chemical	Hardness	Weight
	White, black, gray, green, yellow, blue, red, orange, brown, etc.	Texture • Gritty— Sandy • Powdery— Earthy or chalky • Smooth— Glass • Smooth & sticky— Waxy • Sharp— Metallic	Color of the mineral when it's scratched across a streak plate	• Earthy • Sour • Sweet • Rotten egg • Other	• Glassy/vitreous- shines like glass • Earthy/chalky-dull • Metallic-looks like metal • Waxy/silky/pearly- has a muted shine	Attracts to a magnet Yes or No	Reacts to acid (fizzes) Yes or No	Mohs Scale Scratched by 1 2 Fingernail 3 4 Penny 5 Steel (knife blade) 6 Glass 7-10 will scratch steel/glass	Specific gravity weight goes from very light (Diatomite) to very heavy (Magnetite)

THE ROCK CYCLE

rock\ˈrak\ *n:*

ROCKS! WHAT ARE THEY? Rocks are aggregates of any combination of minerals (Quartz, Calcite, Galena), elements (S-sulfur, Au-Gold), solid organic material (coal), and/or other rocks.

The relative abundance of the three rock groups in the Earth's crust:



ROCKS = MINERALS ± ELEMENTS ± SOLID ORGANICS ± OTHER ROCKS

IGNEOUS ROCKS

Ultimately the parent of all other rocks.

Magma is hot molten rock material generated within the Earth. When magma reaches the surface it is called **lava.** Igneous rocks are the result of cooling and crystallization of magma and lava**.**

These include **intrusive** rocks that crystallize below the Earth's surface (granite, gabbro), and **extrusive** rocks that crystallize on the Earth's surface (obsidian, rhyolite, basalt).

Intrusive igneous rocks cool slowly, producing a *coarse texture* with mineral grains visible to the naked eye. The minerals that form are determined by the chemistry of the magma and the way that it cools (relatively slowly or quickly, steadily or variably). The grains are typically interlocking, and of more-or-less the same size.

These rocks can vary in *color* from almost white to dark green and black, including varying tones of gray, pink, and red.

Granite	Light-intermediate color, quartz present
Diorite	Intermediate-dark color, quartz absent
Gabbro	Dark color (very), few light minerals

Large, irregular *intrusive rock masses* are called **batholiths** (e.g. the Sierra Nevada). **Dikes** are tabular igneous bodies formed vertically or across sedimentary bedding. Those formed horizontally or parallel to bedding are called **sills.**

Extrusive igneous rocks (sometimes called volcanic) cool quickly, which causes very small crystals to form, if any at all. This produces *fine-grained rocks*, which without a microscope, can be identified only by color. The *color* is determined by the minerals that form during cooling.

Like the intrusive rocks, the minerals formed reflect the chemistry of the magma. Colors vary from white to black, with pink, tan, and gray being common intermediate colors. The *texture* of these rocks can also be influenced by the amount of gas trapped in the lava when it cools.

Rhyolite	Usually pink or tan, sometimes white
Obsidian	Volcanic glass, often black but many colors are possible
Andesite	Intermediate-dark color
Basalt	Dark gray or gray-green to black

SEDIMENTARY ROCKS

Rocks formed from the consolidation of loose sediment (Sandstone) or from chemical precipitation (Limestone) at or near the Earth's surface.

Sedimentary rocks are formed by the weathering (physical and chemical) of igneous, metamorphic and other sedimentary rocks. The weathered fragments are transported via water, air or ice before they are deposited and transformed.

Sediments are transformed into rocks by:

- **Cementation,** usually by calcite, silica or iron oxides that glue the fragments together.
- **Compaction,** fragments being squashed together.
- **Re-crystallization,** which produces interlocking textures.

Sedimentary rocks generally occur in layers or beds that range in thickness from inches to thousands of feet. Their texture ranges from very fine grained, to very coarse. Colors include red, brown, gray, yellow, pink, black, green and purple.

Examples of sedimentary rocks are: limestone, sandstone, shale, conglomerate, gypsum, calcite

METAMORPHIC ROCKS

Rocks derived from pre-existing igneous and sedimentary rocks.

The original rock has been changed in form by the Earth's temperature, pressure and chemical fluids to form a new metamorphic rock. Examples would include areas where an igneous intrusion forces its way through the Earth's crust resulting in pressure and temperature changes due to conducted heat, force and friction.

Metamorphism can also occur in areas of stress such as faulting and folding of rock or in areas of plate tectonics such as the oceanic crust colliding into the continental crust. The principal characteristic of metamorphic changes is that they occur while the rock is solid.

Texture characteristics are very important in classifying metamorphic rocks. They range from very fine grained to coarse grained minerals. Metamorphic rocks can be divided into two textural groups, foliated (layered) and unfoliated (not layered).

Foliation: Parallel layers of minerals, sometimes of different composition, giving the rock a distinctive planar to platy feature (Schist, Gneiss).

Unfoliated: No preferred orientation of minerals. The rock has no preferred orientation of breakage (Quartzite and Marble).

Rock Cleavage: A property of a rock that allows for easy breaking along parallel planes or surfaces. Metamorphic rocks tend to break or cleave most easily along planes parallel with foliation.

Original Rock	Metamorphic Rock
Mudstone/Shale	Slate
Shale	Chlorite Schist
Basalt/Gabbro	Biotite Schist
Granite/Diorite	Gneiss
Limestone/Dolomite	Marble
Quartz-rich Sandstone	Quartzite

PLATE TECTONICS:

The surface of the Earth is always shifting and moving. The oceanic plates are mostly made of dense basaltic rock and the continental plates are mostly made of lighter granitic igneous, sedimentary and metamorphic rocks. When an oceanic plate collides with a continental plate it is most often pushed beneath the continental plate.

This subduction process carries the rock to increased temperature and pressure zones within the Earth's crust and mantle, eventually causing the rock to become molten magma. New sources of volcanic or intrusive igneous rocks can form from the material to begin another cycle.

PLATE TECTONICS WITH AN ORANGE

PURPOSE: To acquaint students with the concept of plate tectonics.

MATERIALS: oranges (one for each student or two can share)
clay or play dough (optional)
toothpicks

INSTRUCTIONS:

1. Have the students peel the orange without the use of a knife and in as few pieces as possible. This peel represents the Earth's crust and the crust is in pieces just like the orange peel.

2. Have the students lay the orange peel on their work surface and record their observations.

3. Tell the students to replace the peel on the orange, securing the peel with toothpicks.

DISCUSSION:

1. The Earth is spherical like the orange although it is difficult to see the roundness of the earth except from space.

2. What did the students observe when the orange peel was laying on their work surface? Did they notice that the pieces flattened out. The pieces didn't appear to be as round as they were when attached to the orange.

3. Now that the peel is back on the orange, this better represents the Earth's crust. The cracks are called faults and it is the shifting of the plates (orange peel) which causes earthquakes and volcanic activity.

EVALUATION:

1. How do the continents fit into this theory?

OPTIONS: Since most of the fault lines on the Earth's crust are not visible, the students may wish to roll out a thin piece of clay (or play dough) and cover the orange. They should carefully remove the toothpicks as the clay is placed.

Minerals and YOU

You wake up in the morning and switch on the light. You wash your face, brush your teeth, and get dressed. You turn on the radio and eat breakfast—a bowl of cereal, a glass of juice, perhaps some toast and a cup of coffee or tea. You look out the window, then head for the door—ready to start the day.

And almost everything you've done so far—and everything you'll do for the rest of the day—would be impossible without minerals.

Water pipes and electric wiring; refrigerator, radio, toaster, lamp, and light bulb; sheets, towels, and clothing; soap and toothpaste; window, cereal bowl, juice glass, coffee cup; water faucet, spoon, doorknob—all were made from or with minerals. Even breakfast reached your table with the help of

Minerals and the Modern World

Minerals touch our lives in hundreds of ways each day. Life as we know it would not exist without them. Everything that cannot be grown—that's neither plant nor animal—is a mineral or made from minerals.

Agriculture, construction, manufacturing, transportation, electronics, art, science—almost every area of human activity depends in some way on minerals. The raw materials we take out of the ground are as critical to our way of life—and life itself—as food and water.

We consume minerals in amounts that range from billions of tons of sand and gravel a year to only thousands of pounds of rhenium—a metal used in producing lead-free gasoline. In the United States alone, it takes more than 2 billion tons of minerals each year to maintain our way of life. That's about 10 tons of minerals for every man, woman, and child. From those minerals we get the products we need to live and those that make life more comfortable.

Agriculture

Our dependence on minerals begins with the most basic requirement for life—food. Minerals are essential to the many activities involved in putting food on our tables. Fertilizers made from potash, phosphate rock, sulfur, and nitrogen help plants grow. Farmers use metal tractors and combines to plant and harvest crops. They ship fruit, vegetables, grain, and livestock to market in trucks, railroad cars, and airplanes—all made of metal. Food processors use metal machines and equipment; they package food in metal cans and other containers made from or with minerals.

In addition, like all plants and animals, we need mineral nutrients to keep us alive and well. The foods we eat supply iron, calcium, phosphorus, magnesium, copper, zinc; we even take vitamins containing minerals to make sure we get enough.

Construction

Minerals provide the building blocks for the houses and apartment buildings we call home; for the towns and cities where we live, work, and play; and for the roads, highways, and bridges that connect them.

We find the products of pits, quarries, and mines from basement to attic, from parking garage to penthouse. Our houses, apartment buildings, offices, and factories have walls of brick, stone, concrete . . . roofs made from asphalt and gravel . . . concrete foundations and gypsum wallboard . . . metal air conditioners, furnaces, and ventilation ducts . . . and a network of copper pipes, wires, and cables that bring water, light, and power.

Other minerals and mineral-based materials used in construction include cement, sand, clay, tile, lime, glass, aluminum, iron and steel, lead, and zinc.

As long as civilization as we know it endures, minerals will be there, playing an essential part in our daily lives.

Manufacturing

Many of the goods and products we use each day are made from minerals. Stoves, TVs, refrigerators, microwave ovens, washing machines, radios, and dishwashers contain steel, aluminum, and other metals. Aluminum pots and stainless steel kitchen utensils . . . brass doorknobs and picture frames . . plates and porcelain vases made from China clay . . . metal tools, bolts, screws, and nails . . . soaps and detergents made from boron, phosphates, soda ash . . . toothpaste, aspirin tablets, lipstick, eye shadow and other cosmetics containing clay—we find mineral products in every room, closet, and cabinet.

Many materials that are not in themselves minerals could not be made without them. We use sand, selenium, silicon, soda ash, and other minerals to manufacture glass. Making paper may require clay, lime, or sodium sulfate. Minerals like titanium, lead, and cadmium help give paints their color; white talc, mica, and clay help them last longer.

Minerals actually make possible the manufacture of almost every product bought and sold today. The machines used in factories, plants, mills, and refineries are made from steel and other metals. The processes involved in refining petroleum, making steel, and producing textiles, paper, glass, plastics, and fertilizers depend on chemicals made from minerals.

Transportation

In the modern world, minerals take us wherever we want to go—from the local shopping center to the moon. If we want to move people and materials, we need minerals. Cars, trucks, and buses; trains, subways, and the rails they run on; barges, ships, and the cranes that unload them—all are made from metal.

Cars, for example, contain iron and steel, manganese, chromium, lead, zinc, platinum, copper, and aluminum. We drive them on streets, highways, and bridges made from asphalt, sand, gravel, and concrete. Road crews use sand and salt to keep them from skidding on snow and ice. Even the gas in their tanks was prepared using mineral-based chemicals.

Minerals carry us into the air and beyond the atmosphere. Jets made of aluminum, chromium, cobalt, columbium, tantalum, and titanium take off by the thousands each day. Satellites, missiles, and space orbiters depend on the permanence, strength, reliability, and corrosion resistance of these metals. Gold used in the space suits of astronauts and as thin coatings on equipment protects both from the deadly radiation and heat of the sun.

Electronics

The advances in electronics and computer technology that made possible the exploration of space and hundreds of other technical achievements would be inconceivable without minerals.

Copper, for example, transformed the way we live. Its ability to conduct electricity not only gave us new ways to light and heat our homes, but opened the way to a world of machines that can do almost anything except think. And today's computer scientists are working on that.

Directly or indirectly, the electronics and computer industries use almost every mineral mined today.

It takes 42 different minerals, for example, to make something as seemingly simple as a telephone handset. From aluminum and beryllium to yttrium and zinc—minerals put light, power, communication, information, and entertainment at our fingertips.

Art and Science

Minerals provide the materials for men and women to express and explore themselves and the world. Painters and sculptors use mineral products—pigments, clay, marble. The photographer and movie maker would have no art without silver—the metal that makes it possible to record images on film. Symphony orchestras, brass bands, and rock superstars make music with instruments made from metal; listening to recorded music would be impossible without equipment made of a wide range of minerals.

The instruments of science—from microscopes and supercomputers to test tubes and beakers—also depend on minerals. With these instruments, scientists have explored the world from cell to solar system, discovering new treatments for disease, new sources of energy, even new galaxies.

Less positively, minerals have been a part of human warfare since the first caveman cast the first stone. Yet, today, that too is changing—minerals are being used in almost every aspect of our efforts to ensure world peace.

Makeup— A Wealth of Minerals

Have you ever read the ingredients in makeup, shampoo, or toothpaste? It might surprise you. Many personal-care products contain a wealth of mineral materials taken from the Earth. Take, for example, eye shadow:

One of the first ingredients listed in eye shadow is usually talc - a magnesium silicate mineral. Its platy crystal habit is in part the reason why talc has been an important ingredient in cosmetics since 3500 B.C. The plates glide smoothly across each other, allowing makeup to be applied easily. They lie across the pores in the skin and lessen the chance of clogging pores, while providing texture to the skin. Yet they are translucent enough not to be seen.

Talc is resistant to acids, bases, and heat and tends to repel water. In addition to eye shadows, talc is used in loose and pressed powders, blushes, is a filler in some deodorants, and is added to lotions and creams. Talc can also be found in chewing gum and pharmaceuticals.

Mica, a mineral widely used in eye shadows, powder, lipstick, and nail polish, is added to give luster or pearlescence to a product. Mica is resistant to ultraviolet light, heat, weather and chemical attack and adheres to the skin. Like talc, it has excellent slip characteristics and may be used to replace talc in a makeup. When coated with iron oxide, mica flakes sparkle with a gold tint.

Kaolin, a clay, is added to makeup to absorb moisture. It covers the skin well, will stay on the skin, and is resistant to oil. Kaolin and another clay, bentonite, are added to the earth-based face masks or packs predominately for their cleansing effects. Clays are also used as fillers in different products.

Powdered calcite, a calcium carbonate, absorbs moisture. Because of this, calcite and a magnesium carbonate, processed from dolomite, are added to powders to increase the ability of the makeup to absorb moisture.

When it comes to makeup, color is the name of the game. Minerals provide the color to eyes, cheeks, lips, and nails. Iron oxide, one of the most important color minerals, was used by Cleopatra in the form of red ochre as rouge.

Today, iron oxides give red, orange, yellow, brown, and black tones to makeup. Chrome oxides are used for greens; manganese violet for purple; ground lapis lazuli may be added to makeup for blue. Ultramarine blue and pink coloring is made from a mixture of kaolin, soda ash, sulfur, and charcoal.

Even gold has historically been used as a colorant. Ancient Egyptians used gold to color skin and hair. Gold can still be found in powders and other makeup to add a 'rich' golden sheen to the skin.

As an artist starts a painting with a bright white canvas to give the colors brightness and intensity, titanium dioxide is added to brighten and intensify the color of makeup, and to give whiteness and opacity. Titanium dioxide is also a natural sunblock and, like talc, iron oxides, and gold, it has been used for centuries. Titanium dioxide can be found in any makeup—shadow, blush, nail polish, lotions, lipstick, and powders. Titanium dioxide also makes Oreo cookies frosting extra-white and is the "M" on M&M's candy.

Minerals also find their way into health-care products we use daily. Salt is effective in treating skin disease and is used in some soaps. Fluorite, processed for fluoride, is added to toothpaste and drinking water to help prevent tooth decay.

Calcium carbonate (calcite) and baking soda (nahcolite) are abrasives in toothpaste. A borax and beeswax mixture is added to cleansing creams as an emulsifier to keep oil and water together. Boric acid is a mild antiseptic and is added to powder as a skin-buffering agent.

Zinc oxide is added to creams to allow the cream to cover more thoroughly. Zinc oxide ointment, which contains approximately 20% zinc oxide, is used to heal dry, chapped skin. When an unlucky hiker runs into poison ivy, calamine-base lotions are often used to soothe the itchy skin. Calamine is another name for hemimorphite, a zinc silicate mineral.

As you can see, minerals are found in many things we use. So, the next time you are in the supermarket, take a moment and acquaint yourself with the multitude of minerals that are a part of our daily lives.

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A Brief List

Industrial Minerals Used Around the House

Carpet— *Calcium carbonate, limestone*
Glass/Ceramics— *Silica sand, limestone, talc, lithium, borates, soda ash, feldspar*
Linoleum— *Calcium carbonate, clay, wollastonite*
Glossy paper— *Kaolin clay, limestone, sodium sulfate, lime, soda ash, titanium dioxide*
Cake/Bread— *Gypsum, phosphates*
Plant fertilizers— *Potash, phosphate, nitrogen, sulfur*
Toothpaste— *Calcium carbonate, limestone, sodium carbonate, fluorite*
Lipstick— *Calcium carbonate, talc*
Baby powder— *Talc*
Hair cream— *Calcium carbonate*
Counter tops— *Titanium dioxide, calcium carbonate, aluminum hydrate*
Household cleaners— *Silica, pumice, diatomite, feldspar, limestone*
Caulking— *Limestone, gypsum*
Jewelry— *Precious and semi-precious stones*
Kitty litter— *Attapulgite, montmorillonite, zeolites, diatomite, pumice, volcanic ash*
Fiberglass roofing— *Silica, borates, limestone, soda ash, feldspar*
Potting soil— *Vermiculite, perlite, gypsum, zeolites, peat*
Paint— *Titanium dioxide, kaolin clays, calcium carbonate, mica, talc, silica, wollastonite*
Concrete— *Limestone, gypsum, iron oxide, clay*
Wallboard— *Gypsum, clay, perlite, vermiculite, aluminum hydrate, borates*
Spackling— *Gypsum, mica, clay, calcium carbonate*
Pencil— *Graphite, clay*
Carbon paper— *Bentonite, zeolite*
Ink— *Calcium carbonate*
Microwavable container— *Talc, calcium carbonate, titanium dioxide, clay*
Sports equipment— *Graphite, fiberglass*
Pots and pans— *Aluminum, iron*
Optical fibers— *Glass*
Fruit juice— *Perlite, diatomite*
Sugar— *Limestone, lime*
Drinking water— *Limestone, lime, salt, fluorite*
Vegetable oil— *Clay, perlite, diatomite*
Medicines— *Calcium carbonate, magnesium, dolomite, kaolin, barium, iodine, sulfur, lithium*
Porcelain figurines— *Silica, limestone, borates, soda ash, gypsum*
Television— *35 different minerals and metals*
Automobile— *38 different minerals and metals*
Telephone— *42 different minerals and metals*

FIREWORKS DEPEND UPON MINERALS

Take a moment to consider the minerals that make fireworks such a spectacular part of the festivities. Each color in a fireworks display is produced by a specific mineral compound:

- Bright greens are made with barium.
- Deep reds are a product of strontium.
- Blues come from copper.
- Yellows require sodium.

More colors can be created by mixing compounds. Strontium and sodium together produce a brilliant orange. Titanium, zirconium and magnesium alloys combine to make a silvery white. Copper and strontium mix to yield a lavender.

Certain minerals are used for special effects. Iron filings and small particles of charcoal produce gold sparks. If you want a loud flash, fine aluminum powder is the fuel to choose. Larger particles, such as small flakes or granules, give a longer, shower-like effect. Magnalium, a magnesium-aluminum alloy, can produce a tiny series of silvery-white flashes. Aluminum, antimony sulfide and perchlorate are some flash mixtures.

Although fireworks date back to ancient China, they continue to grow in popularity. Just in the past decade, their use has doubled to nearly 30,000 short tons per year. Of this amount, consumers buy two-thirds. The remainder go for fireworks displays. About 85 percent of consumer fireworks and half of the display variety are imported from China, Japan, Korea and such European countries as France and Italy.

The role of minerals in fireworks is just one example of society's growing reliance upon minerals for the manufacture of everything from automobiles to toothpaste.

U.S. Bureau of Mines, Office of Public Information
Provided by Women In Mining Education Foundation

Materials Standards Compliance
Creating a Universe
Grade Levels: K-12

Grades K-4
Idea Starters for the Periodic Chart
Type: Lessons & Activities
Science K-4.A (Science as Inquiry)
Science K-4.B (Physical Science)
Science K-4.C (Life Science)
Science K-4.D (Earth and Space)
Science K-4.E (Science and Technology)
Science K-4.F (Personal and Social)
Science K-4.G (History & Nature of Science)

Rock Cycle
Plate Tectonics
Minerals and YOU
Makeup and Minerals
Type: Lessons & Activities
Science K-4.A (Science as Inquiry)
Science K-4.B (Physical Science)
Science K-4.D (Earth and Space)
Science K-4.E (Science and Technology)
Science K-4.F (Personal and Social)

Grades 5-8
Idea Starters for the Periodic Chart
Type: Lessons & Activities
Science K-4.A (Science as Inquiry)
Science K-4.B (Physical Science)
Science K-4.C (Life Science)
Science K-4.D (Earth and Space)
Science K-4.F (Personal and Social)

Mineral and Rock Match
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Science K-4.F (Personal and Social)

Grades 9-12
Idea Starters for the Periodic Chart
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Science K-4.C (Life Science)
Science K-4.F (Personal and Social)

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